power supply switch for disabling said current to said laser diode if said current exceeds said value;

a power control circuit loop including the components of said sensing circuit, said comparator and power supply switch operably connected to a microprocessor to positively verify operation of said components, and means to disable said laser diode if operation of any of said components is not positively verified; and

a remote computer monitoring the pulse frequency and duration of said laser diode and means to disable said laser diode if predetermined pulse and duration values are exceeded.

14. (AMENDED) A laser driver control circuit containing P-channel MOSFET connected to the power input of said circuit which allows the preselected input power polarity to pass and which turns off if an opposite input power polarity is received.

Remarks:

I **Objections**

Claim 2 stands objected to because the word "date" in line 2 should read –data-. Amended claim 2 rectifies this problem, as suggested by the Examiner.

The drawings stand objected to because reference numeral 20 was previously used to designate two different parts in Figure 1. As suggested by the Examiner, the leftmost "20" has been changed to 26. Amended Figure 1 is included herewith, illustrating the corrections in red ink. The drawings stand objected to because they do not include reference numerals 26, 46, and 90, mentioned in the description. As described above, numeral 26 appears in amended Figure 1. Figure 2 has been amended to include reference numeral 46, identifying the current sensing circuit. The specification has been amended to delete reference numeral 90, rectifying the issue giving rise to the Examiner's objection. The drawings stand objected to because they include reference numeral 34, not mentioned in the description. Amended Figure 1 omits numeral 34. All the problems with the drawings identified by the Examiner have thus been rectified, and the Examiner's approval thereof is respectfully solicited.

II Rejections Under 35 U.S.C. §112

In the Office Action dated July 31, 2002, claim 12 stands rejected as indefinite. The Examiner's suggestion, i.e. substituting the word "deactivate" for "reactivate," has been incorporated herein, and withdrawal of the rejection is therefore respectfully solicited.

III Rejections Under 35 U.S.C. §102

In the Office Action dated July 31, 2002, claim 1 stands rejected as anticipated by Chambers et al. Claim 1 has been amended to include the limitation: "wherein said laser diodes are operable to simultaneously provide laser beams." In contrast to the invention of claim 1, Chambers discloses a device wherein only one of the laser diodes supplies the laser beam: "In the embodiment of Fig. 1, WDM 25 functions as an optical OR device between lasers 15A and 15B and coupler 30" (Chambers specification col. 4, lines 65-7). Chambers' use of the optical OR device limits the Chambers system to providing a single laser beam at a time, i.e. simultaneous provision of laser beams is not possible. Claim 1 therefore recites limitations not taught by the cited reference, the rejection is overcome, and Applicant respectfully requests withdrawal of the same.

Claim 12 stands rejected as anticipated by Freitag et al. In particular, the Examiner states that Freitag discloses a control circuit that is on even when the laser is not. Claim 12 has been amended to recite the limitation that the activated control circuit "includes said laser diode." Freitag does not teach "activating a control circuit that includes said laser diode at a current level less than the current threshold to activate said laser diode," as recited in claim 12. Rather, in the Frietag design, the current through the circuit controlling the laser diode (and the diode itself) remains at zero until activation. Thus, the "control circuit" of Frietag, consisting of B1 (206), Q1 (210), RPOT (218), the 2.0V reference, the 1.5V reference, and R1 (212), is completely deactivated, rather than activated at less than the laser diode current threshold as required by claim 12. In the invention of claim 12, there is a current flowing through the laser even when the laser is turned off. By keeping the control loop "alive" while the laser is turned off, the turn on time is shorter and the impulse response of the laser beam is smoother, advantages not available with the Freitag design. Freitag thus does not teach all the limitations of the

present invention, the rejection is overcome, and withdrawal of the same is respectfully requested.

Claim 14 stands rejected as being anticipated by Vermeersch et al. Claim 14 has been amended to recite a "P-channel" MOSFET rather than a MOSFET (Spec. p. 9, line 8). In Vermeersch Fig. 8, the schematic illustration of the circuit illustrates the MOSFET as an N-channel MOSFET. Because Vermeersch does not teach all the limitations of the present invention, the rejection is overcome. Moreover, Applicant's invention using a P-channel MOSFET is not merely an obvious variation of the design taught by Vermeersch. Referring to Figure 8 in Vermeersch, when V+ is above the ground, the body diode (not shown in Fig. 8) of the MOSFET is reversely biased. When polarity of the power supply is reversed, i.e. V+ is below ground, the body diode is forward biased, allowing current to pass through the laser diode. When the voltage applied to the laser diode is above the maximum reverse voltage allowed, usually 2 V or 3 V, the laser diode will be permanently damaged. The power supply voltage V+ is usually either 5 V or 3.3 V. If this voltage is applied in reverse polarity, the laser diode will receive the 3.3 V or 5 V, above the maximum reverse voltage allowed, permanently damaging the laser. In contrast, Applicant's invention does not have these problems. The body diode (not shown) in the MOSFET of Applicant's invention has its anode connected to the drain and cathode connected to the source. Reversing polarity in the circuit causes the body diode to become reversely biased, and the MOSFET turns off since its gate voltage is then the same as the source voltage. Thus, Applicant's design offers the advantage of protecting the laser under circumstances that would damage a laser in the Vermeersch design. Accordingly, withdrawal of the rejection to claim 14 is respectfully requested.

IV Rejections Under 35 U.S.C. §103

In the Office Action dated July 31, 2002, claims 2-7 stand rejected as being unpatentable over Freitag et al. in view of Jabr. Claim 2 has been amended to include the limitation that one of the stored parameters is laser output power, and has also been amended to recite the step of "continuously monitoring said laser output power." In contrast to the invention of claim 2, Freitag teaches a "window detector 224" for detecting overpowering of the laser. Because a window detector as taught in Freitag

monitors laser powering in discrete temporal segments, i.e. "windows," a sampling period that encompasses a relatively high-power pulse of a laser operating in a pulsed mode can trigger shutdown of the system. This could take place even though the relatively high-power pulses, on average, are not overpowering the laser. The Freitag system thus risks false alarms, and would be less well suited to lasers operating in a pulsed mode. In contrast, Applicant's system continuously monitors the laser output power, regardless of whether the laser is operated in continuous-wave or pulsed mode. Incorporating a microprocessor and continuously monitoring the laser output power allows the average output power to be calculated, and the laser shut down or alarm signal generated only when the true average power exceeds the stored operational parameters, not merely when a relatively large power is detected during the sampled window, as would be the case with Freitag (spec. p. 6, lines 1-4). In particular, Applicant's invention includes a power-safety table stored in the microprocessor's memory. The microprocessor is programmed to know the power it sets on each laser, the time the laser is turned on, and the maximum time period allowed at that power by the laser safety standards. A look up in this power safety table will obtain the maximum on time length allowed at a particular output power (spec. p. 6, lines 10-12). By requiring that the laser output power be continuously monitored, claim 2 recites a limitation absent from Freitag, and the suggested combination of Freitag and Jabr cannot present a prima facie case of obviousness.

In a similar vein, claim 4 is directed to the method of claim 2 wherein the laser pulse duration and laser pulse peak output power are included in the monitored power-safety parameters. The Examiner asserts that Freitag discloses that the power safety parameters may be output power and pulse duration. Contrary to the Examiner's assertion, however, Frietag does not disclose measuring pulse duration when the laser is operating in a pulsed mode. The "pulse" referred to in line col. 3, line 26 of Freitag is an abnormal high power pulse, i.e. a fault condition. Applicant has amended claim 4 to better emphasize this distinction, adding the limitation: "during pulsed mode laser operation." Thus, claim 4 recites limitations absent from the cited reference, and the rejection is overcome. The rejections to claims 2-7 are therefore overcome, and Applicant respectfully requests withdrawal of the same.

Claim 8 stands rejected as unpatentable over Chambers. The Examiner would read Chambers as teaching a system with "a microprocessor 50, at least one laser driver 20 and a corresponding laser diode 15A." In particular, the Examiner asserts that it is well known to place parts of a circuit on a printed circuit board. Claim 8, however, requires both a host microprocessor and a remote microprocessor, the host microprocessor being positioned on the PCB. The remote microprocessor is not required by claim 8 to be located on the PCB. Chambers discloses only a single microprocessor, which cannot be said to be both a host and a remote microprocessor; the two types are by definition mutually exclusive. By designing a laser driver whose components can primarily be located on the same circuit board, the present invention provides a compact, relatively inexpensive system. Claim 8 therefore teaches limitations absent from Chambers, and withdrawal of the rejection thereto is respectfully solicited.

Claim 13 stands rejected as unpatentable over Freitag in view of Jabr and further in view of Noda. As previously stated with regard to claims 2-7, the statements incorporated by reference herein, Freitag teaches a window detector, not a comparator capable of continuously monitoring current. As such, Frietag is less well suited to laser diode operation in a pulsed mode, and the proposed combination would present the risk of false alarms. Claim 13 has been amended to emphasize this distinction Applicant's invention holds over Freitag, i.e. continuous monitoring of the current to the laser. Because the proposed combination does not teach all the limitations of claim 13, the rejection is overcome.

WHEREFORE, all the pending claims are believed to be in condition for allowance, which is respectfully solicited. If the Applicant may further assist in the prosecution of this application in any way, the Examiner is invited to contact the undersigned at (248) 364-2100.

Respectfully submitted,

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APPENDIX

Amended Version of Specification Illustrating Changes:

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The laser driver [90] is preferably provided with a unique low drop out voltage protection circuit which is shown in Figure 5. This circuit uses a P-channel power MOSFET (Metal Oxide Silicon Field Effect Transistor) Q. When the polarity is correct, i.e. VPS+ is higher than the ground (GND) in potential, Q is turned on. Otherwise, when the input power supply polarity is wrong (reversed), i.e. VPS+ is lower than GND in potential, Q is turned off. This circuit is simple, low cost, and, in addition, the drop out voltage is low, usually 0.1 Volt or less. Comparing with a protection circuit built using a diode (the drop out voltage would be at least 0.3 Volt), this circuit consumes 3 or more times less power and passes the power supply voltage to the laser driver circuit without much power supply voltage being dropped out.

Amended Version of Claims Illustrating Changes:

1. (AMENDED) A laser driver for generating [a beam of] coherent light comprising:

at least two laser diodes mounted in combination with a single thermo-electric temperature control means; and

a microprocessor for controlling and/or monitoring the activation of said laser diodes and said thermo-electric temperature control means;

wherein said laser diodes are operable to simultaneously provide laser beams.

2. (AMENDED) A method of controlling and/or monitoring a laser diode with a microprocessor having memory storage of [date] data, the method comprising:

storing in said memory power-safety parameters of said laser diode with said microprocessor during operation of said laser diode, wherein one of said parameters is laser output power; [and]

continuously monitoring said laser output power; and

disabling operation of said laser diode whenever said one or more parameters are exceeded.

4. (AMENDED) The method of claim 2 wherein said parameters include laser pulse duration and laser pulse peak output power <u>during pulsed mode laser operation</u>.

12. (AMENDED) A method of controlling a laser diode comprising:

activating a control circuit [to] <u>that includes</u> said laser diode at a current level less than the current threshold to activate said laser diode;

activating said laser diode by increasing the current in said control circuit above said threshold for a specified duration; and

reducing said current below said threshold to [reactivate] <u>deactivate</u> said laser diode.

13. (AMENDED) A laser driver control system comprising:

at least one laser diode, a circuit for sensing the current through said laser diode, comparator for <u>continuously</u> comparing said current to a predetermined value, and power supply switch for disabling said current to said laser diode if said current exceeds said value;

a power control circuit loop including the components of said sensing circuit, said comparator and power supply switch operably connected to a microprocessor to positively verify operation of said components, and means to disable said laser diode if operation of any of said components is not positively verified; and

a remote computer monitoring the pulse frequency and duration of said laser diode and means to disable said laser diode if predetermined pulse and duration values are exceeded.

14. (AMENDED) A laser driver control circuit containing <u>P-channel</u> MOSFET connected to the power input of said circuit which allows the preselected input power polarity to pass and which turns off if an opposite input power polarity is received.